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TREATMENT OF INDUSTRIAL WASTES IN MUNICIPAL SEWAGE TREATMENT PLANTS*

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TREATMENT OF INDUSTRIAL WASTES IN MUNICIPAL SEWAGE TREATMENT PLANTS
TECHNICAL ASPECTS

The continued search for economical methods for treatment of industrial wastes may be expected to keep combined treatment with domestic sewage ever in the foreground. In addition, there is the intangible aesthetic value of removing waste treatment from the premises of industrial establishments. These considerations create a real incentive to make combined treatment work. The increasing number of new and renovated municipal sewage treatment works, designed to treat trade wastes, clearly indicates the trend in waste treatment. This paper reviews some of the pertinent factors related to this subject.

UNACCEPTABLE WASTES

Any waste which, either by itself or through reaction with another, interferes with normal functioning of sewers or the operation of a sewage treatment works, should be excluded from the sewers. Explosive and flammable substances are by their very nature prohibited. Liberation of certain dissolved gases can create a serious corrosion problem at the treatment works as well as annoy the operators. Toxic materials should be excluded unless they are diluted to concentrations, at the point where they enter the sewer, which will not inhibit biological activity. Petroleum oils represent another type of waste which municipal plants are not equipped to handle. Control of industrial waste discharge to municipal sewerage systems is usually accomplished by regulations enforced by ordinance (1).

RESPONSIBILITY OF INDUSTRY

It is the responsibility of industry to control the process waste discharge to the sewers in such manner that combined treatment is feasible. This means

that the industrial representative charged with waste control and treatment should become familiar with the operation of the municipal treatment works which provides his industry with this service. Likewise, the treatment works superintendent must have full knowledge of the characteristics of trade wastes being discharged to the sewers. This mutual interest is of major importance in contributing to success of combined treatment.

Segregation of Wastes from Clean Waters

This is a relatively simple problem when considered as part of the design for a new industrial plant. It becomes more complex and costly for the older plants having an intricate network of sewers and other underground conduits. Although the concentration of pollutional materials varies inversely with dilution, economies are usually realized by reducing the volume to a minimum.

Controlled Discharge

Through instrumentation and automatic controls, it is possible for industry to regulate each process with precision. An equally effective system of controls can be provided by industry to regulate discharge of process wastes and to maintain a continuous accurate record of the rate and period a given waste is released. Such a system of control precludes the interruptions at a municipal treatment plant inevitably caused by promiscuous dumping.

When flow equalization tanks at the industrial site are required, they should be so designed that sludge will not be retained. Retention in the equalization tanks should be held to a minimum consistent with optimum loading at the municipal plant. Extended storage of unstable wastes will encourage anaerobic decomposition which may cause odors to develop in the primary units.

Controlled discharge becomes increasingly important as the industrial load becomes a significant portion of the total waste load. In general, combined treatment is facilitated by maintaining the waste-sewage ratio reasonably constant. In waste treatment, like any process, it is propitious to keep the untreated waste as uniform in composition and volume as practicable (2).

Pretreatment

There is no unanimity of opinion regarding the desirability of or need for pretreatment. Some operators are agreeable to receiving most any treatable waste that will pass through the sewers. Pretreatment is most valuable as a means of reducing the load on a municipal plant having limited capacity. Screening is the simplest form of pretreatment and is particularly applicable to vegetable canneries, tanneries, and paper mills. Sedimentation may be employed with or without chemicals but sludge disposal always presents a problem.

Grease is a nuisance in small sewers and at treatment plants. When present in quantity, it is advisable to recover as much as practicable at the source. Flotation devices are employed varying from simple grease traps to elaborate grease collectors using compressed air. Acid treatment is useful if the grease is in an emulsified state. The foregoing examples of pretreatment are typical but each case should receive individual study.

TREATMENT WORKS DESIGN

The first requisite in considering combined treatment is the treatment works design. The Allegheny County Sanitary Authority's program is typical of

a well organized plan for handling industrial wastes (3). This program and the treatment works design were based on thorough study of the wastes from thirty industries to be served, in addition to chemical examination of the discharge from thirty-two major municipal sewer outfalls. It is significant that all industrial wastes in the Pittsburgh area were considered acceptable for treatment except pickle liquor wastes and acid mine drainage.

The design of a sewage treatment works to receive both domestic sewage and a combination of industrial wastes frequently develops into a Herculean task. This is particularly true when the receiving stream requires a high degree of treatment. Review of the possible treatment systems available to the designing engineer is beyond the scope of this paper. It should suffice to caution that such designs should allow for the maximum in flexibility of operation and should provide liberal reserve capacity.

TREATMENT WORKS OPERATION

Treatment of sewage and industrial wastes covers any artificial process to which the wastes are subjected in order to remove or alter their objectionable constituents. The important fact is that we are dealing with a "process" and this spells operation requiring an operator. Regardless of how modern a waste treatment works may be or how well it may be designed for the particular job it is expected to do, its effectiveness will depend largely on the manner in which it is maintained and operated. The operator must know his plant, have full knowledge of the wastes to be treated, and understand the limitations of the waste treatment process to obtain continuous satisfactory performance.

Primary Treatment

Sedimentation of a combined waste (industrial wastes and domestic sewage) may differ in any of several ways from a normal domestic sewage. Difficulties or differences that have been observed are due to a variety of causes, including:

1. Change in character of waste from decomposition in sewers.
2. Variation in density and settling rate of suspended solids.
3. Increase in floating material.
4. Prevalence of odors.
5. Solubility of suspended solids.
6. Compacting of sludge.
7. Sludge volume increase.

Each problem should be thoroughly studied before operations are modified. There will usually be more than one way to improve each of these operation difficulties. In some cases, the relief from one condition may tend to aggravate another. Improved efficiency can be accomplished by chemical precipitation when this added cost is warranted. Use of coagulants increases the volume of sludge and materially alters its character.

Secondary Treatment

Stabilization of wastes by oxidation units is effected through aerobic biochemical action. The objective is to establish and to maintain the optimum environment for maximum biological activity. Efficient treatment requires control of such variables as: oxygen supply, organic load, pH, and temperature. Upsets are caused by waste combinations which rapidly change these variables.

The trickling filter is a consistently effective type of biological treat-

ment. High-rate filters, with relatively high B.O.D. loadings, are applicable where a high quality effluent is not required. The "alternating double filter" developed by the British Water Pollution Research Laboratory constitutes still another modification (4).

Although the trickling filter can tolerate substantial variations in character of applied waste, it does possess some disadvantages, all of which are augmented by trade wastes. Because of odors, trickling filters are not considered suitable for built-up districts. Prolonged high organic loading tends to cause pooling; however, this can be alleviated by using larger rock. "Psychoda" flies are often a serious pest.

Activated sludge is sensitive to substantial changes in character of wastes and organic loading. Wastes high in carbohydrates are particularly detrimental to the process. These include dairy, brewery, corn canning, and starch. The high oxygen demand and rapid decomposition of these wastes, with production of organic acids, disrupts normal biological activity. Such wastes stimulate fungus growths which, if not controlled, cause "bulking."

Much research has been conducted in recent years in an effort to make the activated sludge process less sensitive to shock loads and to control the sludge index. Notable success has been achieved in this work by Kraus at Peoria, Illinois (5). The Kraus process consists of converting digested sludge to activated sludge in a sludge treatment aeration tank, after which it is interchanged with the activated sludge in the normal activated sludge part of the plant. This process not only eliminated sludge bulking at Peoria but also made it possible to apply greater loadings to the aeration tanks and higher settling rates in the final settling tanks than was possible with the conventional activated sludge process.

DIGESTION

Sludge digestion units are provided to partially stabilize sewage solids so that dewatering and disposal may be accomplished without creating a nuisance. The anaerobic decomposition of organic solids is a seemingly simple process. However, the conditions for maximum rate of digestion must be controlled within reasonably narrow limits. It is not uncommon for solids from the process industries to materially alter these conditions resulting in very active digestion, or the reverse, cause biological activity to virtually cease. Important considerations in sludge digestion have been described by Schlenz and Buswell (6) (7).

SUMMARY

There are numerous types and combinations of industrial wastes currently being treated in municipal sewage treatment plants. There is reason to believe that this practice will be continued and expanded. Let us proceed on the basis of facts, let us proceed with caution, but above all let us proceed.

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